COTTON EXPORTS: ANALYSIS OF THE RELATIONSHIPS BETWEEN SALES AND SHIPMENTS

Elias T. Ayuk and Fred J. Ruppel

Abstract

Relationships between cotton export sales and export shipments are examined, and a quarter-specific lag structure is estimated. Two econometric systems are estimated, one employing export shipments and the other using export sales. Results indicate that sales are more sensitive to changes in economic variables than shipments and that stocks net of outstanding export sales are more responsive to price and interest rate changes than gross stocks. Sales and shipments are different variables and cannot substitute for one another in econometric modelling. Use of export sales data should be considered in estimation of export demand and stock demand parameters.

Key words: exports, (export) sales, international trade, cotton, cotton marketing, stocks, stock demand.

Major changes have occurred in the U.S. cotton export sector in the past decade. During the 1970's, the U.S. typically enjoyed a market share of 20 to 30 percent of a growing world cotton trade, peaking at 36 percent in 1979. U.S. cotton exports began to level off with the dollar appreciation of the early 1980's and dropped dramatically during 1985 when the combination of the high-valued dollar and growing world excess supplies pushed world prices below U.S. support prices for the first time in years. Faced with growing stocks, the U.S. Congress (via the 1985 Farm Bill) authorized the USDA to implement a marketing loan program for cotton in order to bring the U.S. price more in line with world prices.

Two problems are inherent in designing specific commodity policy. The first is that the U.S. presumably has no control over production and consumption decisions outside its borders. With a Chinese decision toward self-sufficiency in cotton production, a major importer of U.S. cotton was lost. Furthermore, Chinese producers overshot the self-sufficiency goal, and China became a net exporter of cotton, again costing the U.S. a portion of its export market.

The second problem is that policy decisions are based in part on parameter estimates of U.S. (and world) production and consumption responses to changing economic conditions. A decision to enhance farm income through planted acreage restrictions will be effective only if there is an inelastic aggregate demand response to the resulting price increase. One of the most important parameters affecting U.S. cotton is that of the elasticity of foreign demand for U.S. cotton exports. This parameter has been estimated on many occasions by numerous researchers, each employing different time periods, methodologies, model structures, and underlying assumptions. Aggregate estimates of the price elasticity of foreign demand for U.S. cotton exports range from highly inelastic (Blakely; Cathcart and Donald; Green and Price) to highly elastic (Johnson; Liu and Roningen; Wohlgenant).

Our primary contention in this paper is that previous estimates of the price elasticity of foreign demand for U.S. cotton suffer from model mis-specification due to the use of export shipments data in the estimation process. Export shipments stand in contrast to export sales. The distinction between the two variables is important because of the extensive use of forward sales contracts in cotton export marketing, with importers purchasing cotton on a given date and requesting delivery sometime in the future. Economic variables, political events, and institutional structures may change significantly between sale of the commodity and its actual shipment. Ruppel

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(1984) has asserted that export sales is an *economic* variable, responding to commodity prices, exchange rates, and world income levels, whereas export shipments should be viewed as a *logistical* variable, responding to transportation capacities, weather constraints, and importer desired delivery dates. Ruppel (1984) explored institutional and empirical relationships between export sales and export shipments of corn, soybeans, and wheat. He found very different export demand and stock demand parameter estimates for corn between econometric models using export shipments data and models using export sales. Results for wheat and soybeans were less conclusive.

To date no work has been done utilizing cotton export sales data. The present study incorporates export sales into econometric modelling of the cotton export sector. In addition, quarterly data are used in the estimation process instead of annual data. This is due in part to the small number of annual observations of export sales data available. However, the estimation of parameters using quarterly data allows for short-run price and quantity projections and impact analysis. Furthermore, since it is generally accepted that elasticities are smaller in the short run, elasticity estimates obtained through the use of quarterly data will be biased downward with respect to annual data and reflect "lower-bound" estimates. The next two sections contain an overview of the cotton export sector and a brief description of the export sales data, including an analysis of the relationship in time between export sales and export shipments. Then a theoretical framework for incorporating export sales into empirical analyses is discussed. Finally, we specify and estimate two systems of equations, the first a "traditional" system in which the export demand equation is estimated using cotton export shipments and a second in which cotton export sales are incorporated into the analysis.

BACKGROUND INFORMATION

Cotton is a major U.S. export crop, consistently ranking fourth among field crops in cash receipts from export marketings ($2.4 billion in 1984).[1] Over the past decade, approximately fifty percent of total U.S. cotton production has been exported. Major destinations include Japan, Korea, Taiwan, Indonesia, Hong Kong, and Thailand. In both 1982/83 and 1983/84 these six countries accounted for approximately two-thirds of all U.S. cotton exports. Much of this cotton returns to the U.S. in the form of textile imports, competing with our own textile manufacturing sector. Because of the importance of the cotton export sector to domestic cotton producers and domestic textile manufacturers, it is imperative that we obtain good estimates of economic parameters affecting U.S. cotton export levels.

While export sales and export shipments are both quantity measures of export activity, there are large numerical discrepancies between the two variables due to time lags between the sale of the commodity and its actual delivery. We might expect these discrepancies to be large in the short run but to cancel out over longer time spans. This is not the case for cotton. In Table 1, calendar and marketing year annual data for net export sales (gross sales less cancellations) and export shipments of cotton between 1974 and 1986 show large differences between the two variables. In comparing annual data for corn, soybeans, and wheat, Ruppel (1987) found half the differences between sales and shipments to be less than five percent. By contrast, with cotton calendar year data, only one set of observations has less than a 15 percent difference between cotton sales and shipments. The marketing year data are more related, but still only one-fourth of the sets of observations differ by less than five percent, and in more than half the cases, the difference is greater than ten percent. The correlation coefficient over the thirteen pairs of calendar year numbers is only 0.40, and over the twelve pairs of marketing year data, 0.75, further verifying the lack of similarity between the two variables. These numbers compare with Ruppel's (1987) correlation coefficients of 0.82, 0.84, and 0.91, over calendar year data, and 0.81, 0.87, and 0.95 over marketing year data for corn, soybeans, and wheat, respectively. The fact that cotton calendar year annual sales and shipments are less highly related than marketing year data suggests a higher degree of within-marketing-year sales and ensuing shipments and fewer between-marketing-year contracts.

Over a given time period, net export sales and export shipments show large or small dif-

[1]That figure fell to $1.6 million in 1985 and $773 million in 1986 in anticipation of a marketing loan for cotton beginning with the 1986-87 marketing year (*Foreign Agricultural Trade of the United States*, ERS, USDA).

ferences depending on the beginning and ending levels of "outstanding export sales." Outstanding sales is the measure of those sales which have been contracted but not yet shipped. The level of outstanding sales increases with new export sales and decreases with export shipments and sales cancellations (Ruppel, 1987). For the time period covered in this study (1974–1986), quarterly beginning outstanding export sales of cotton averaged 3101 thousand running bales (TRB, 480-pound bales), ranging from a low of 804 to a high of 7294 TRB. Actual shipments averaged only 1394 TRB, indicating that on average more than twice as many bales of cotton were contracted for at the beginning of a quarter than actually were shipped during the quarter.

The average ratio of beginning outstanding sales to ensuing shipments was 2.52, ranging from a low of 1.25 to a high of 9.10. Thus in every quarter there had been enough cotton sold on a forward contract basis to fully meet shipment demands during that quarter. The mean ratio of beginning quarterly outstanding sales to shipments in that quarter is highest for the first marketing quarter (August–October, 3.47), followed by the fourth marketing quarter (May–July, 2.61), second (November–January, 2.13), and third (February–April, 1.86). The sizes and ranges of these ratio values point to the existence of a seasonally varying lead/lag relationship between export sales and export shipments of cotton. In the next section, we explore this empirical relationship.

TABLE 1. COTTON EXPORT SALES AND EXPORT SHIPMENTS: ANNUAL DATA BY CALENDAR AND MARKETING YEARS

CALENDAR YEAR[a]			MARKETING YEAR[a]		
YEAR	SALES	SHIPMENTS	YEAR	SALES	SHIPMENTS
1974	821.1	4807.1			
			1974/75	1343.3	3962.3
1975	1609.1	3994.4			
			1975/76	4356.9	3367.2
1976	5374.3	3655.8			
			1976/77	5546.1	4844.9
1977	5886.9	4739.6			
			1977/78	5416.3	5657.2
1978	5455.3	6307.8			
			1978/79	6675.3	6240.1
1979	9221.8	7203.8			
			1979/80	8675.8	9203.3
1980	5616.5	8412.2			
			1980/81	4529.0	5939.7
1981	6811.7	5606.2			
			1981/82	6405.8	6515.4
1982	4554.4	6418.6			
			1982/83	6025.8	5077.7
1983	7173.4	5434.7			
			1983/84	6943.4	6675.4
1984	6586.9	6778.1			
			1984/85	4338.2	6166.4
1985	2171.8	4905.7			
			1985/86	3802.4	1844.4
1986	6231.9	3477.3			
Mean	5193.5	5518.6		5338.2	5457.8
Standard Deviation	2381.4	1463.3		1861.1	1863.5
Coefficient of Variation	0.46	0.27		0.35	0.34
Correlation Coefficient	0.40			0.75	

[a]Sales and shipments data (1000's of 480-pound bales) are from various issues of *U.S. Export Sales*, FAS, USDA.

THE TEMPORAL RELATIONSHIP BETWEEN EXPORT SALES AND EXPORT SHIPMENTS

The results above suggest high levels of "new crop" purchases in the fourth marketing quarter and/or low levels of shipments in the first quarter. This is consistent with Ruppel's (1984, 1987) results for corn, soybeans, and wheat. He found the fourth marketing quarter (just prior to the harvest) to be typically the highest quarter for export sales and the lowest quarter for export shipments, while the first and second marketing quarters were the highest shipment quarters. He reasoned that importers were buying forward in the old marketing year for delivery in the new. Sales and shipments patterns in cotton, however, are different from those in corn, soybeans, and wheat. The highest quarter for both sales and shipments is the third quarter of the marketing year, where the mean of sales is 1447 TRB, and the mean of shipments is 1791 TRB. The second and fourth marketing quarters are the next highest sales levels, at 1339 and 1314 TRB, respectively, with the first marketing quarter lowest at 1122 TRB. For shipment levels, the second marketing quarter is the second highest with a mean of 1523 TRB, followed by the fourth quarter at 1309 TRB and the first quarter at 951 TRB.

The large volume of second and third quarter shipments is not surprising. The high degree of cotton processing prior to export shipment contrasts dramatically with corn, soybeans, and wheat, where the commodity can move directly from the field to the dock with minimal handling and no processing. Cotton ginning is highest during the first few months following the harvest. Presumably only small amounts of cotton can be shipped during the first marketing quarter due to limited availability of newly-ginned lint, especially if carryover of the old crop has been small. It may also be true that domestic manufacturers have made plans to purchase new crop cotton for first quarter delivery, thereby making export shipment even more unlikely in the first quarter. The high amount of sales in the third marketing quarter is not explained easily. It may be that buyers wait to see the exact outcome of the Northern Hemisphere crop before making their purchase decisions or that sellers with debt repayment obligations need to sell their merchandise.[2] In either case, it is uncertain whether these third marketing quarter sales point to sales and shipments in the same quarter, or to forward sales into the fourth and first quarters.

Further insight into the relationship between cotton export sales and export shipments can be gained by analyzing the lead/lag relationship econometrically. Following Ruppel (1987), quarterly export shipments were regressed on quarter-specific values of current export sales, export sales lagged one and two periods, and beginning outstanding export sales lagged two periods. These right-hand-side variables were constructed as quantity variables multiplied by [0,1] marketing quarter dummy variables, such that each of the sixteen right-hand-side variables received a value only once every four quarters.

The estimated equation is presented in matrix form in Table 2. The columns indicate the shipment marketing quarter (MQ1-MQ4), and the rows indicate the lag structure on the sales variables (LAG0, LAG1, LAG2, BOS2). The cells of the matrix are labelled according to shipment quarter and lag structure: Q1L0 refers to first marketing quarter shipments with a zero lag structure on sales (i.e., current sales), Q3L1 represents third quarter shipments sold during the second marketing quarter (one quarter prior), and Q4B2 reflects fourth quarter shipments which existed as beginning outstanding export sales two periods ago (i.e., sales had been made three or four quarters earlier). Each cell contains an estimated coefficient and t-statistic, together with a means-adjusted coefficient and the quarter in which the sale was made (in parentheses, brackets, and braces, respectively). The means-adjusted coefficients (which have been adjusted by quarter-specific sales means) sum to approximately one and can be interpreted as the percentage of annual export shipments with a particular shipment-quarter/lagged-sales structure. The intercept coefficient was small and insignificant and is reported together with summary statistics at the end of the table.

The estimated equation explains approximately 90 percent of the variation in cotton export shipments. This high explanatory power together with the insignificance on the intercept and the sum of the means-adjusted coefficients approximating unity implies that the equation specification captures the full

[2]The authors thank an anonymous journal referee for this insight.

TABLE 2. EXPORT SHIPMENTS AS A FUNCTION OF QUARTER-SPECIFIC CURRENT AND LAGGED EXPORT SALES AND LAGGED BEGINNING OUTSTANDING SALES, 1975–1986[a]

	MQ1	MQ2	MQ3	MQ4
	Q1L0	**Q2L0**	**Q3L0**	**Q4L0**
LAG0	0.12	0.40	0.05	−0.01
	(1.23)	(2.30)	(0.45)	(−0.11)
	[.026]	[.101]	[.013]	[−.003]
	{1}	{2}	{3}	{4}
	Q1L1	**Q2L1**	**Q3L1**	**Q4L1**
LAG1	0.33	0.30	0.49	0.32
	(2.41)	(2.54)	(3.19)	(2.47)
	[.081]	[.066]	[.118]	[.088]
	{4}	{1}	{2}	{3}
	Q1L2	**Q2L2**	**Q3L2**	**Q4L2**
LAG2	−0.04	0.23	0.43	0.07
	(−0.34)	(1.80)	(3.44)	(0.53)
	[−.012]	[.056]	[.081]	[.016]
	{3}	{4}	{1}	{2}
	Q1B2	**Q2B2**	**Q3B2**	**Q4B2**
BOS2	0.16	0.12	0.21	0.24
	(2.68)	(1.73)	(3.30)	(3.28)
	[.083]	[.059]	[.109]	[.134]
	{2,1}	{3,2}	{4,3}	{1,4}
Intercept	−25.1			
	(−0.17)			
R^2 = 0.92		$\bar{R}^2$ = 0.88	D−W = 2.15	d.f. = 31

[a]The dependent variable is export shipments per quarter; the independent variables are quarter-specific current and lagged values of export sales and lagged beginning outstanding export sales. Columns (MQi) are marketing quarters. Rows (LAGj, BOS2) are current and lagged values of export sales, where j indicates the lag length (0-2) and BOS2 is the beginning outstanding sales level lagged twice. The QiLj and QiB2 cell labels refer to marketing quarter-lag length relationships. "t"-statistics are in parentheses; means-adjusted coefficients are in brackets; sales quarters are in braces.

realm of forward sales activity. Of the 16 coefficients, 11 are significant at a 5 percent level (in a one-tailed sense). A lack of significance on a coefficient implies that the associated lag structure for that shipment quarter is relatively unimportant.

The right-hand-side variables can be analyzed horizontally by lag length, vertically by shipment quarter, and diagonally by sales quarter. The most surprising result is the strength of the longer lag structures (BOS2), where we find nearly 40 percent of total shipments associated with sales contracted more than two quarters prior. Three of the six largest means-adjusted coefficients are in this row, and long forward sales are important to shipments in each quarter. The other dominant lag structure is the one quarter lag where another 35 percent of total shipments can be accounted for by sales in the previous quarter. We see significant concurrent sales and shipments only in the second marketing quarter. The analysis by shipment quarter shows that third and fourth marketing quarter shipments are based on the dominant lag structures, LAG1 and BOS2, but that current sales are important for second quarter shipments, and only the longer lags are important for first quarter shipments. Finally, by sales quarter, first quarter sales are important for fourth, third, and second quarter shipment, in that order. Second quarter sales are important for second and third quarter shipment, while third quarter sales are important for fourth quarter shipment. Fourth quarter sales are very important for third and fourth quarter shipment and, to a lesser degree, for first and second quarter shipment.

The results of Table 2 refute the notion of concurrent sales-shipment activity in cotton export markets. Instead, we find forward contracting to be the standard, with only the second marketing quarter manifesting significant contemporaneous sales and shipments. The significance of the long lags in cotton contrasts dramatically with Ruppel's (1987) results for corn, soybeans, and wheat, where he found contemporaneous and one-quarter-lag sales and shipments to account for 70 percent or more of total export shipments for all three commodities.

Three other equations were estimated, quarterly export shipments regressed on quarterly export sales and three quarterly dummy variables and calendar and marketing year annual export shipments regressed on calendar and marketing year annual export sales. The intent was to test the null hypothesis that (except for seasonality differences in the quarterly data) sales and shipments were "identical," that is, that the coefficients on the sales variables would be equal to one. The Cochrane-Orcutt corrected equation over quarterly data yielded a coefficient estimate of 0.124 with a t-statistic of −8.88 (47 d.f.), favoring rejection of the null hypothesis. The calendar year annual data equation resulted in a sales coefficient of 0.247 with a t-statistic of −4.44 (11 d.f.), again supporting rejection of the null hypothesis. The marketing year annual data equation resulted in a sales coefficient of 0.754 with a t-statistic of −1.18 (11 d.f.), which favored not rejecting the null hypothesis. Thus, we cannot conclude that the two variables are "identical" on a quarterly basis or on an annual basis when calendar year annual data are used. In these cases the use of shipments data where sales data are preferred will likely result in misleading, if not incorrect results. In the following sections this premise is subjected to further testing through the structuring of two econometric systems, one using export shipments and the other using export sales data. The results of these estimations lend further support to the hypothesis that export sales and export shipments are different variables and should not be interchanged.

MODEL SPECIFICATION OF U.S. COTTON EXPORTS

A model for the estimation of the demand for U.S. exports of cotton lint typically is specified as a system of equations. Beginning supply (the sum of ginnings and carry-in inventories from the previous period) can be assumed to be exogenous. Beginning supply of cotton fiber is set equal to total demand, which consists of three components, domestic disappearance or domestic mill use (DD), export demand (XD), and the demand for ending stocks (SD). Domestic disappearance can be expressed as

$$(1)\ DD_t = g(DD_{t-1}, PC_t, PS_t, DI_t, MQi_t),$$

which states that domestic disappearance is a function of its lagged value, the price of cotton fiber (PC), the price of use substitutes for cotton (PS), per capita disposable income (DI), and marketing quarter dummy variables for the first three quarters of the marketing year (MQi_t). The use substitutes for cotton fiber are polyester, rayon, and other man-made fibers.

Export demand refers to all cotton fiber sold for use by foreign textile producers. This equation can be estimated as

$$(2)\ XD_t = h(XD_{t-1}, PC_t, PS_t, XRT_t, FGNP_t, MQi_t),$$

which expresses export demand as a function of its lagged value, the price of cotton fiber, the price of substitutes for cotton, the exchange rate (XRT), foreign income (FGNP), and quarterly dummy variables. The exchange rate used in this study is the USDA cotton trade-weighted index. The index is weighted by country purchases of U.S. cotton export and is a "real" index (bilateral exchange rates are deflated by relative inflation rates). The foreign income variable is a trade-weighted index of foreign real GNP, where the G-10 countries plus Switzerland provide the weights (see Batten and Belongia).

The demand for ending stocks is the final component of total demand. The level of ending stocks is certainly a function of the beginning stock level. In addition, the decision to hold stocks of ginned cotton lint is based on (present and near-future) manufacturing needs and on potential positive returns to stockholding by other market participants. If these market participants expect prices to rise such that the expected future price exceeds the current price plus the cost of storage, they will hold more stocks. Thus the demand for ending stocks can be represented as

$$(3)\ SD_t = f(BS_t, PC_t, TBL_t, MQi_t),$$

where PC and MQi_t are as defined above, BS is the level of beginning supply, and TBL is the rate of interest on 6-month U.S. treasury bills. The use of the current price in place of the expected future price can be defended by assuming that all information contained in expected future prices is also contained in spot prices (the efficient market hypothesis).

Beginning supply is composed of ginnings (GN) plus lagged ending stocks. Equating beginning supply with total demand yields

(4) $GN_t + SD_{t-1} = DD_t + XD_t + SD_t,$

which is the equilibrum condition for the system. Equations (1), (2), (3), and (4) form what we will refer to as a "traditional" supply-demand model for U.S. cotton lint. With these four equations, four endogenous variables are determined: domestic disappearance, export demand, ending stocks, and cotton price.

In the traditional system, export demand parameters are estimated by equation (2) with export shipments as the dependent variable. In order to construct a system which utilizes export sales as the dependent variable in the export equation, a new equilibrium condition needs to be developed. The level of beginning supply is not necessarily consumed domestically, exported, or held as ending stocks. It can be held as outstanding export sales (sales which have been contracted for later delivery) at the end of the period. When no distinction is drawn between sales and shipments, these outstanding sales are simply end-of-period stocks. The mathematical definition of outstanding sales (OS) links net export sales (XSA, gross sales less cancellations) and export shipments (XSH):

(5) $OS_t = OS_{t-1} + (XSA_t - XSH_t).$

That is, the ending level of outstanding sales increases over its value at the beginning of the period when current (net) export sales are greater than current export shipments.

Outstanding export sales are included in ending stocks. However, the outstanding sales portion of ending stocks is clearly not available for general distribution but is in fact "encumbered." When a distinction between sales and shipments is incorporated into the analysis, ending stock demand must be redefined. Net stock demand (NSD) is defined as gross stocks (SD) less outstanding export sales:

(6) $NSD_t = SD_t - OS_t.$

Net stock demand represents the demand for cotton fiber by farmers, gin operators, domestic millers, speculators, and government officials for stocks to be carried into the following period. Lagged net stock demand can also be expressed mathematically as in equation (6). These two equations plus equation (5) can then be substituted into equation (4) and rearranged to yield a new equilibrum condition:[3]

(7) $GN_t + NSD_{t-1} = DD_t + XSA_t + NSD_t.$

Equation (7) is structurally identical to equation (4), but the export sales variable replaces export shipments and NSD_t replaces SD_t. The export demand equation (2) can now be estimated with export sales as the dependent variable. Domestic disappearance is unchanged in the alternative model. However, a new stock demand equation reflecting net stock demand must be estimated. Finally, a fourth equation needs to be estimated in the alternative model which now has six endogenous variables (domestic disappearance, net stock demand, export sales, export shipments, outstanding export sales, and price), one equilibrum condition (7), and an identity (5). This fourth equation can be either an outstanding sales equation or an export shipments equation. Since this study focuses on the distinction between export sales and export shipments, a non-traditional export shipments equation will be estimated. In summary, the following two systems will be estimated econometrically: (1) domestic disappearance, export demand (with export shipments as the dependent variable), and stock demand in the traditional model and (2) domestic disappearance, export demand (with export sales as the dependent variable), export shipments (as a logistical variable), and net stock demand in the alternative model.

ECONOMETRIC RESULTS

Table 3 contains the results of the econometric estimation of the traditional and alternative export demand systems of equations. The equations in the traditional system are columns (1), (3), (5), and (7), with (2), (4), (6), (8), and (9) constituting the alternative system. Both systems were estimated using three-stage least squares estimation procedures with 48 marketing quarter observations covering calendar years 1975 to 1986. All

[3]Note that XD_t and XSH_t, though conceptually different, are numerically equal.

Table 3. Three-Stage Least Squares Estimation of Traditional and Alternative Cotton Export Demand Systems of Equations, Quarterly, 1975-1986

Independent[b] Variables	Dependent Variables[a,b] Domestic Demand (1)	(2)	Export Price (3)	(4)	Stock Demand (5)	(6)	Export Shipments (7)	Export Sales (8)	Export Shipments (9)
DEP_{t-1}	0.49	0.46	—	—	0.61	0.42	0.40	−0.07	0.45
	(4.42)	(4.25)			(6.53)	(6.57)	(3.63)	(0.45)	(2.45)
PCD/PCX[c]	5.51	7.50	1.43	1.44	−73.5	−89.16	−7.32	−3.75	—
	(0.90)	(1.34)	(21.04)	(23.51)	(3.57)	(3.81)	(0.84)	(0.39)	
	[0.14]	[0.20]			[−0.44]	[−0.96]	[−0.76]	[−4.99]	
PCD_{t-1}	−11.59	−12.88	—	—	—	—	—	—	—
	(2.13)	(2.57)							
	[−0.31]	[−0.34]							
DI	0.25	0.24	—	—	—	—	—	—	—
	(3.62)	(3.67)							
	[0.35]	[0.34]							
TBL	—	—	—	—	−67.91	−110.0	—	—	—
					(1.26)	(1.76)			
					[−0.09]	[−0.25]			
FGNP	—	—	—	—	—	—	27.89	19.30	—
							(2.04)	(1.31)	
							[1.94]	[1.35]	
XRT	—	—	—	—	—	—	−15.07	−23.13	—
							(1.58)	(1.85)	
							[−0.91]	[−1.40]	
LCUS	—	—	—	—	—	—	1593.6	7465.9	—
							(0.96)	(3.64)	
							[1.09]	[5.13]	
XSA	—	—	—	—	—	—	—	—	0.16
									(1.53)
XSA_{t-1}	—	—	—	—	—	—	—	—	0.33
									(4.31)
XSA_{t-2}	—	—	—	—	—	—	—	—	0.13
									(1.45)
MQ1	109.4	104.8	0.64	0.64	4161.1	3453.4	−97.5	−130.3	−104.7
	(2.11)	(2.07)	(0.34)	(0.34)	(8.67)	(6.89)	(0.63)	(0.67)	(0.76)
MQ2	444.4	438.2	2.27	2.27	5817.3	6285.1	588.2	84.8	602.0
	(8.26)	(8.34)	(1.21)	(1.21)	(14.35)	(13.08)	(3.34)	(0.43)	(4.20)
MQ3	276.3	281.1	3.85	3.85	525.7	1664.5	612.7	196.7	639.5
	(5.83)	(6.11)	(2.06)	(2.06)	(1.06)	(3.46)	(4.66)	(1.01)	(5.60)
INTERCEPT	287.2	331.6	−7.19	−7.23	3467.4	3625.2	−2791.8	−5438.5	−153.9
	(1.77)	(2.12)	(2.30)	(2.53)	(2.12)	(2.33)	(1.49)	(1.98)	(0.72)
"R^2"[d]	0.77	0.78	0.90	0.90	0.89	0.88	0.64	0.48	0.79
D.W.	—	—	0.57	0.57	—	—	—	1.92	—
Durbin h	−0.72	−0.31	—	—	3.57	3.08	2.01	—[e]	1.54
d.f.	40	40	43	43	41	41	39	39	40

[a] See text for variable definitions. Equations (1), (3), (5) and (7) constitute the traditional system, with (2), (4), (6), (8) and (9) forming the alternative system. Absolute values of t-statistics are in parentheses. Elasticities calculated at variable means are in square brackets; those calculated from adjusted coefficients are in pointed brackets (see text).

[b] Dependent and independent variables are compiled from the following sources (selected issues): domestic demand, stock demand (ending stocks), and PCD are from *Cotton and Wool: Situation and Outlook Report*, ERS, USDA; export sales and export shipments are from *U.S. Export Sales*, FAS, USDA; U.S. export price and LCUS are from *World Cotton Statistics*, International Cotton Advisory Committee; DI is real (CPI adjusted) per capita U.S. Gross National Product from the *Survey of Current Business*; TBL is from *International Financial Statistics*, International Monetary Fund; FGNP is Federal Reserve Board's trade-weighted index of foreign GNP obtained by personal phone call from FRB of St. Louis; XRT is from *Agricultural Outlook*, ERS, USDA.

[c] PCD is used in columns (1)-(6), PCX in columns (7)-(9).

[d] "R^2" is the square of the correlation coefficient between the actual and predicted values of the dependent variable.

[e] Durbin h could not be computed.

quantities are in 480-pound TRB's, and all prices and incomes are inflation adjusted. The average price received by farmers for upland cotton fiber (PCD) was used as the price variable for the domestic demand and stock demand equations, while the U.S. cotton price c.i.f. Liverpool (PCX) was used in the export equations. Thus a price linkage equation was included in both estimations and is reported in columns (3) and (4). For each equation, the estimated coefficients are reported with the absolute value of the associated t-statistics in parentheses. Unless specified otherwise, all references to significance levels are with respect to a two-tailed, 5 percent level of significance. Elasticity estimates (where appropriate) are in brackets. What is reported as "R^2" is the square of the correlation coefficient between the observed and predicted value of the dependent variable (because R^2 is invalid in three-stage least squares estimation).

The domestic demand equations (columns 1 and 2) and the price linkage equations (columns 3 and 4) were structurally identical between the two systems, with the resulting parameter estimates identical in sign and similar in magnitudes and significance levels. Because the focus of this paper is on differences between the two systems, the domestic demand and price linkage equations are not discussed in detail. Two points are worth noting however. First, the lagged domestic price was included in the domestic demand equations together with the current domestic price because of historical forward contracting arrangements between cotton users and cotton producers. Second, the inclusion of the polyester price as a use-substitute would have been appropriate in the domestic demand equation, but the high correlations between that price and PCD and between a polyester-to-cotton price ratio and PCD prohibited its use.

Parameter estimates from the demand for ending stocks equations were very different between the two systems. Both the domestic price and the interest rate (TBL) were negatively related to ending stock demand as expected, with the price coefficient significant in both equations but the interest rate insignificant in the traditional system (column 5) and significant at a 10 percent level in the alternative system (column 6). A dramatic finding was the much greater price and interest rate responsiveness in the net stock demand equation than in the gross stock demand equation. The price elasticity of net stock demand (−0.96) was more than double the related parameter in the gross stock demand equation (−0.44), with the interest rate elasticity with encumbered stocks netted out (−0.25) nearly triple that of gross stock demand (−0.09). Since stock demand is the obverse of stock supply, these findings suggest that total cotton availability is much more responsive to price and interest rate changes when encumbered stocks are netted out.

On further reflection the above results are not surprising since the elasticities were calculated at the variable means and the net stock demand means are much smaller than are the gross stock demand means. In addition, these results are in agreement with Ruppel's (1984) findings for corn, soybeans, and wheat. Though the Durbin h statistic (which is appropriate to use with lagged dependent variables on the right hand side) points to the presence of serial autocorrelation in the stock demand equations, no corrections were employed.[4] Cochrane-Orcutt corrected OLS equations were estimated however, and the net stock demand price and interest rate elasticities remained more than double the gross stock demand elasticities, lending confirmation to the findings above.

The export demand equation of the traditional system (column 7) had export shipments as the dependent variable. Since the argument being made in this study is that export shipments is (and has been in the past) the incorrect variable to use in an export demand equation, to estimate export shipments in this fashion is to set up a "straw man" model for comparison with the export sales equation of the alternative model (column 8). The explanatory variables in the shipments equation explained one-third more variation in the dependent variable than did the right-hand-side variables in the sales equation. However, much of this explanatory power was due to non-economic variables, including the lagged dependent variable and the marketing quarter dummy variables. Of the economic variables, only foreign income (FGNP) was significant at a 5 percent level, with the U.S. cotton export price (PCX), the exchange rate (XRT), and the ratio of the Liverpool cotton index "A" price to the U.S. export price (LCUS) not significantly different from zero. The reported coefficient on PCX is only a portion of the price impact on export shipments,

[4]Because of the presence of two endogenous variables in the price linkage equation, correction for serial autocorrelation in these export demand systems of equations is not at all straightforward. However, it was felt that the gains from 3SLS estimation outweighed the negative consequences of serial autocorrelation.

since the U.S. price also appears as the denominator of LCUS. When the partial derivative with respect to the U.S. price is calculated from the estimated equation, the adjusted coefficient becomes −20.31, which is still insignificant (t = −0.60).

In the export sales equation, the economic variables provided the explanatory power. Coefficients on XRT and LCUS were significant at a 5 percent level, with FGNP significant at a 10 percent level. As with the export shipments equation in the traditional system, the reported price coefficient is only a portion of the price impact on export sales. Calculating the partial derivative as above yielded a coefficient of −133.23, which was also significant at a 5 percent level (t = −3.49). Coefficients on the marketing quarter dummy variables and the lagged dependent variable were insignificant, contributing to the low explanatory power of the estimated equation ("R^2" = 0.48).

The final equation of the alternative system was an estimate of export shipments using non-traditional non-economic right-hand-side variables (column 9). This export shipments equation was explained by its lagged value, current and past values of export sales, and seasonal dummy variables. With the sales coefficients evaluated in a one-tailed sense (as were the current and lagged sales coefficients in Table 2), nearly all of the right-hand-side variables in this equation were significant at a 10 percent level, with most significant at a 5 percent level. Seventy-nine percent of the variation in export shipments was explained by this equation specification, nearly twenty-five percent more explained variation for the same dependent variable than the export shipments equation in the traditional model. The signs and magnitudes of the quarterly dummy variables again were indicative of seasonal trends in export shipments.

In comparing elasticity estimates in the export equations of the two systems, we find very different results. The adjusted price and price ratio coefficients were insignificant in the shipments equation of the traditional system but were significant at very high levels and highly elastic in the sales equation. The (adjusted) price elasticity of −4.99 lends support to the Johnson; Liu and Roningen; and Wohlgenant findings of highly elastic price responses in cotton exports, while the price ratio elasticity of 5.13 is consistent with Collins' very elastic (3.55) price ratio elasticity. The exchange rate was the third price variable in the sales equation with an (absolute) elasticity greater than unity. All of these variables were either insignificant or inelastic in the shipments equation. Finally, the foreign income elasticity was greater than unity under both specifications, but the calculated elasticity and the significance level were greater in the shipments equation.

CONCLUSIONS

Comparisons between the econometric estimates of the two systems of equations lend additional support to the major contention of this paper, that export sales and export shipments are different variables and should not be interchanged for one another in empirical estimation of cotton export demand parameters. Forward sales contracts allow importers to buy cotton at a time when the purchase price looks favorable and arrange for later delivery. The economic variable is the quantity sold (purchased) of the commodity, not the quantity delivered. Meaningful results cannot be obtained if export sales and export shipments are interchanged.

Comparisons with previous studies are somewhat flawed in that previous research has used shipments data while the present findings are based on sales data. In addition, the time frame for the previous research is annual while the current work is quarterly. In relating the present quarterly sales estimates to annual sales estimates, we would expect the current estimates to be biased downward since economic theory suggests greater elasticities in the long run than in the short run. Though the explanatory power of the export demand (sales) equation in the alternative model is low, export sales of cotton are clearly more sensitive to changes in economic variables than export shipments. Researchers should exercise caution in using export shipments data, especially when short-run projection of economic variables is the research objective.

Owing to the presence of serial autocorrelation, caution should be exercised in directly applying the stock demand results. However these results clearly suggest respecification of existing cotton models which include stock demand equations. Netting out encumbered stocks prior to stock demand estimation is essential. The Ruppel (1984) results over corn, soybeans, and wheat lend additional support. Policy options which use existing cotton stock demand elasticities could be seriously flawed if the anticipation is that higher prices will not result in greater offerings by stock holders.

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